DOCUMENT RESUME

ED 449 036 SE 064 500

AUTHOR Weast, Jerry D.
TITLE Studies of Mathematics Instruction and Curriculum: Implications for the Future. Discussion 4.0.
INSTITUTION Montgomery County Public Schools, Rockville, MD.
PUB DATE 2000-09-00
NOTE 11p.; Produced by Montgomery County Public Schools, Office of the Superintendent of Schools. Attachments are not available from ERIC.
AVAILABLE FROM For full text: http://www.mcps.k12.md.us/info/press/supt-report-on-math.pdf.
PUB TYPE Reports - Descriptive (141)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Educational Change; Elementary Secondary Education; Faculty Development; *Mathematics Instruction; *Teaching Methods
IDENTIFIERS Montgomery County Public Schools MD

ABSTRACT

The absence of a consistently implemented mathematics curriculum and the impact of ineffective teaching practices and instructional leadership in mathematics have a larger responsibility for underachievement by students in the Montgomery County Public Schools than previously realized. This conclusion is supported by three separate studies that found significant variability in classroom instruction, course content, and curriculum organization from school to school and within schools. Information about those three studies is provided, and implications for the future are discussed concerning curriculum, staff development, instructional leadership, policy, and evaluation and assessment. (ASK)

Reproductions supplied by EDRS are the best that can be made
from the original document.

L H Sirkaly

DISCUSSION
4.0

Office of the Superintendent of Schools
MONTGOMERY COUNTY PUBLIC SCHOOLS
Rockville, Maryland

September 25, 2000

MEMORANDUM

To: Members of the Board of Education

From: Jerry D. Weast, Superintendent of Schools

Subject: Studies of Mathematics Instruction and Curriculum: Implications for the Future

ED 449 036

The absence of a consistently implemented mathematics curriculum and the impact of ineffective teaching practices and instructional leadership in mathematics have a larger responsibility for underachievement by students in the Montgomery County Public Schools than previously realized. This conclusion is supported through three separate studies that found significant variability in classroom instruction, course content, and curriculum organization from school to school and within schools.

Background

The studies were conducted in response to a growing amount of evidence suggesting that current underachievement by students is more a reflection of the instructional program than of student ability. The findings suggest that in recent years there has been little if any standardization in the implementation of the system's math curriculum and limited influence by the system on the performance of individual teachers and math departments. In essence, principals and teachers who are achieving high student performance are doing so largely on their own, based on the efficient use of resources and their inherent belief that all children can learn.

The school system's recent achievement of the highest average scores in 27 years in the mathematics portion of the Scholastic Assessment Test (SAT) reflects the immense capability of our students to achieve distinctive results. More students are advancing to higher level courses, including honors courses across subjects and Algebra 2 and beyond in mathematics. Several of our schools are nationally recognized for their student performance. Indeed, there are many excellent teachers of mathematics who produce significant levels of achievement with students in courses spanning the entire field, from the primary understanding of numbers to the college-level expression of mathematical theory and its practical and scientific applications. Such innovative and responsive academic efforts by teachers and principals will be the models for achieving the systemwide changes necessary to propel more of our students to the heights of national and international excellence in mathematics.

At this time, however, there is great variability in student achievement among and within schools of this large and complex school system, coupled with significant and pervasive gaps in student achievement by race and ethnicity. The variability appears to be part of a pattern that seems to

BEST COPY AVAILABLE

go beyond mere chance and happenstance. A major factor in poor student performance – possibly greater than student poverty and language development – is the structure and implementation of the mathematics curriculum itself. This is correctable. The three new studies provide the necessary framework to implement a plan of action that responds to the needs of our students through direct improvements in the mathematics curriculum and the instructional practices of our school system, including staff development, instructional leadership, policy, and evaluation and assessment. A more detailed discussion of the action plan will take place during the Board of Education meeting on October 17, 2000.

Already under way is a series of initiatives to strengthen the content and instruction of mathematics. In addition, the new staff development and teacher evaluation processes are being implemented, both of which are designed to help improve the instructional practices of the school system. These actions were initiated in advance of the most recent studies because the pattern of disparity in student performance and the variability among and within schools were obvious from previous data on student performance. In particular, the high failure rate on the final exam in Algebra I among ninth grade students in the fall semester last year demonstrated the far-reaching aspects of the problems with the mathematics program. Those results echo the disparity in student achievement that was identified in an earlier study of participation in honors and advanced placement courses and reinforced in *Our Call to Action* last November, which prompted many of the initiatives under way at this time.

This memorandum provides a summary of the three studies and an overall framework for the response necessary to ensure that the mathematics curriculum and instructional practices encourage students to achieve the highest standards in every school.

The Three Studies

The three studies focus on the infrastructure and personnel issues related to student achievement, issues upon which the school system can have an immediate and long-lasting impact. The first study focuses on teacher background and preparation for teaching algebra in high school. The second study provides an analysis of middle school mathematics instruction. The third study is an external audit of the entire mathematics curriculum. The studies collectively provide compelling evidence of a systemwide K-12 mathematics program that needs substantial attention.

These are not unexpected results. The two teacher studies conducted by the Office of Shared Accountability were implemented on the hypothesis that teachers have a greater influence on the variability in student performance than previously understood. The audit of the mathematics curriculum by Phi Delta Kappa International, Inc. (PDK) was accelerated because of the implication that schools were not implementing a consistent mathematics program. The audit itself represents the first comprehensive review of a K-12 curriculum in the school system and provides a benchmark for reforms in other instructional areas of the school system.

<u>The Role of Teacher Background and Preparation in Students' Algebra Success</u>

The study of teacher background and preparation in ninth grade Algebra I (Attachment A) found that, when controlling for student ability based on eighth grade achievement, what teachers do

with instruction in the classroom is more important to student learning than who the teachers are according to their credentials. Almost all of the teachers last year in Algebra I were certified to teach math and, on whole, they were more highly educated than teachers statewide. Yet, there was no systematic relationship between the success of teachers and schools to individual teacher education levels, years of teaching experience, certification in math, or completion of in-service training. Teachers with less experience and training were not more or less effective than teachers with higher levels of training. What successful teachers did in the classroom was apparently a more important factor.

An Analysis of Middle School Mathematics, Classroom Observation, and Teacher Interview Data

The study of a sample of middle school mathematics classes (Attachment B) was by grade level and again found great variability in the use of instructional strategies by teachers in their approach classroom instruction. Mathematics frequently was taught as isolated content with little connection to relevant real-world applications. Lessons often took place at a pace too quick for a deep understanding of the material. Students had diverse learning needs that many teachers said they felt unprepared to address – specifically, they said they lacked a repertoire of instructional strategies to respond to the diverse needs of students. The highest rated instruction was found in Grade 6, while the lowest rated instruction was provided in Grade 8.

The Curriculum Management Audit of Mathematics Education

The audit of the math curriculum (Attachment C) described the curriculum as adequate in scope but lacking appropriate guides for teachers in terms of sequence and quality. The use of data for program improvement was found to be ineffective and inconsistent. Monitoring at the building level was found to be inadequate. Staff development was extensive at the time of the audit but largely unfocused and not linked to system priorities. Central office staffing for mathematics was inadequate and therefore did not support quality instruction. Instructional materials were found to be plentiful but there was little direction for their use. The audit itself is an "exception" report structured to hold curriculum up to scrutiny against pre-determined standards of quality. Curriculum audits, by design, do not identify strengths and indicate only relevant findings.

Impact of Tracking and Expectations

The external audit concluded that "tracking by ability" (which, in essence, is tracking by "achievement") negatively impacts African American and Hispanic students. This is an important finding. The study of middle school mathematics reveals a related finding. A careful examination of the final exam results in Algebra I for ninth graders in the Spring 2000 semester – in comparison to previous results for these students on criterion-referenced tests (CRTs) – reveals that tracking can be caused, in part, by the use or misuse of achievement data. For example, when middle schools use CRT results in isolation as a criterion for taking Algebra I in the eighth grade, some students are allowed to take the course while others are not – even though they have similar scores. Furthermore, there are two levels of Algebra I courses in some middle schools – "honors" and "regular." The distinguishing criterion between these two groups is the belief based on CRT scores of who is ready and who is not, even though they are expected to pass the same exam.

These practices cause a variation in both opportunity and student performance in algebra. If course placement is used as a tool to reflect expectations of success and impact the implementation of curriculum, student results become a self-fulfilling prophecy. While this phenomenon disproportionately impacts African American and Hispanic students, all students are affected. The central issue is student access to a quality instructional program.

So strong is this suggestion that it is important to revisit the findings and recommendations of previous studies that addressed similar issues. Among the most recent studies is the 1999 Final Report of the Honors/Advanced Placement Workgroup, which underscored the challenge of ensuring that similarly qualified students have the same opportunities among and within schools to pursue honors and advanced placement courses. In 1994, the Committee Report on Grouping Practices identified the important issues related to how students are assembled in classrooms and the impact of teacher decisions about the sorting of children. In 1990, Dr. Edmund W. Gordon, a Yale University professor, published a landmark report, "A Study of Minority Student Achievement in the Montgomery County Public Schools," which became the foundation for the original *Success for Every Student Plan* in 1991. Among its many important statements was its first recommendation:

> We recommend that priority attention be given to changes in some of the attitudes and behaviors of professional educators (administrators and teachers – majority and minority group member professionals) in regard to (a) their expectations of minority students; (b) their instructional behavior; and (c) their support for the academic development of students.

The urgency of Dr. Gordon's recommendation remains as true today as it did a decade ago. Though the school system is significantly different now with a larger and more diverse population, the fundamental qualities of our professional understanding and commitment to a quality educational program should not have changed. In essence, this reflects the heart of *Our Call to Action* and remains a key to unlocking the potential of our school system.

Our Plan of Action

The audit and studies of classroom instruction were undertaken concurrently with several major changes already under way in the school system. A new team is now leading the mathematics program on a systemwide basis. A new staff development program and a new teacher evaluation system are addressing issues of performance standards and assessment on an individual basis. A comprehensive reorganization of the central administration, including strengthened offices focused on shared accountability, school performance, and student and community support, is aligning resources in direct support of schools. The formation of new school performance teams comprised of instructional and support staff to assist are supporting individual schools. However, these changes are not nearly enough to address the problems identified by the three studies. Further progress will require a stronger, more confident plan of action that identifies the necessary improvements and proceeds systematically to address the problems as they are described in the studies. The following provides an overview of the plans in five targeted areas identified below: Curriculum, Staff Development, Instructional Leadership, Policy, and Evaluation and Assessment.

The action steps will require the involvement of and feedback from all of our stakeholders – teachers, administrators, central office staff, parents, business leaders, and other community members. This will ensure that every member of our school community understands the urgency of the system's response to correcting the issues identified in the three math studies. Already, as a result of *Our Call to Action*, we have focused on the creation of parent- and community-friendly partnerships. We have been working actively to achieve greater involvement by a growing and more diverse community. This involvement among leadership of key constituencies will be critical in the development of strategies that address the needs of students and communities, not only on improved classroom strategies, but also on ways in which parents can help their children with mathematics. Among these strategies is the current development of extended day and Saturday programs for needy students, using $250,000 in community partnership grants in addition to the $1.3 million in extended day funds available through the Collaboration Council.

Of particular help this spring will be the availability of more than $1.2 million in new state funding under the Maryland Intervention and Support Program. Authorized during last year's legislative session, this funding will be used to provide targeted academic intervention services based on student performances on the Maryland School Performance Assessment Program (MSPAP), other standardized tests, and classroom assessments.

Curriculum

The Office of Instruction and Program Development has recently completed a reorganization to provide leadership in the design and implementation of curriculum, especially in mathematics. The goal is to have by the end of next spring for the 2001-2002 school year a comprehensive mathematics curriculum, with scope and sequence for each individual grade, indicating what students need to know and be able to do. The scope and sequence will be aligned with state, national, and international standards and expectations.

The revised mathematics curriculum will broaden the concept of literacy by ensuring that mathematics is connected to meaningful aspects of the real world. To monitor student learning, the assessments will be directly aligned with what students are expected to know. In the classroom, there will be a continuous cycle of instruction and assessment to monitor student learning and inform instruction. Teachers will be supported in learning strategies to modify their practices to meet the needs of diverse learners by implementing research-based best practices. Classrooms will reflect equity of access for all students to receive challenging and rigorous instruction.

To reach the goals addressed in these three studies, the following steps form the core of a preliminary action plan now under development. Under each currently identified action step is an overview of the specific tasks that are being developed to address the needs of our school system. A comprehensive action plan and timeline will be presented on October 17.

1. Develop a new K-12 mathematics curriculum by Spring 2001, with a grade-to-grade scope and sequence that has clearly established goals, objectives, and performance indicators and aligns with Maryland Mathematics Content Standards

1.1. Develop goals and objectives using Maryland Mathematics Content Standards to show what students need to know and be able to do at each grade level

1.2. Write performance indicators for each content strand at each grade level (e.g., students will be able to find the areas of irregular objects)

1.3. Create a matrix showing at what grade level concepts are introduced, developed, mastered, and assessed

1.4. Revise the curriculum to align with scope and sequence

2. Provide principals and teachers with resources and assistance through comprehensive staff development that focuses on providing the highest level of advanced mathematics instruction and expectations possible for all students, especially for African American and Hispanic students

2.1. Use early childhood mathematics specialists to model and coach teachers in implementing the new kindergarten curriculum

2.2. Use Algebra I specialists to provide monthly after-school workshops that will increase the repertoire of instructional strategies used by teachers in the classroom

2.3. Benchmark against other districts across the state and nation that are demonstrating consistent, long-term success in mathematics achievement, especially in terms of closing the gap

2.4. Identify classroom organizational models to meet the needs of diverse learners

2.5. Provide staff development teachers with content training related to raising expectations based on research-based best practices

3. Review and select mathematics instructional materials and resources that are aligned with the scope and sequence of the new curriculum

3.1. Identify and ensure the use of the best textbooks approved for use for grade levels and courses and aligned with the curriculum

3.2. Provide teachers with revised curriculum guides that clearly support the delivery of instruction

3.3. Identify, select, and disseminate instructional resources that are aligned with the revised curriculum

4. Review the local assessment program to ensure congruency with teaching and learning with state, national, and international performance standards and expectations

4.1. Collaborate with the Office of Shared Accountability to review current systemwide assessments (criterion-referenced tests and the Instructional System of Mathematics) and end-of-course exams to determine their future use in the instructional program

4.2. Institute an assessment program that informs instruction on a regular basis for continuous improvement

Already under way at this time, in response to *Our Call to Action* and with funding provided through the Fiscal Year 2001 operating budget, the following activities have taken place.

- Graphing calculators were purchased this year for students' use in school and at home.
- A conference for all secondary leadership teams was convened this past summer on effective instructional practices with emphasis on the use of technology in the mathematics classroom.
- The position of a staff development teacher in each school was established this year to provide immediate support and resources to classroom teachers.
- The positions of early childhood mathematics specialists were established this year to increase use of instructional strategies to meet the needs of diverse learners.
- The positions of Algebra I specialists were established this year to support teachers in improving instruction that will result in greater student success in algebra.

In addition, there are several strategies being developed to further address the needs of schools for the improvement of mathematics instruction.

- Identify and share breakthrough strategies within the school system from individual schools that are successfully delivering mathematics instruction
- Implement a new kindergarten mathematics curriculum including ongoing teacher training and support
- Develop and disseminate draft open-ended assessments in Grades 3 through 8 to help teachers monitor student performance and guide classroom instruction
- Implement a training program for middle school mathematics teachers on the ongoing curriculum and assessment development
- Provide intensive professional development for Algebra teachers through the Algebra I Institute with follow-up coaching and modeling during the school year.
- Provide courses for teachers in mathematics content that include technology, differentiation, and strategies for success in meeting the Maryland Mathematics Content Standards

Staff Development

Building the capacity of all instructional staff is essential for increasing student achievement. A major component of a strong instructional program will be a staff development plan that focuses on knowing "what to teach" and "how to teach it" by strengthening the knowledge, skills, and practices of all staff. The staff development plan will be data-driven and directly linked to system goals. Meeting the diverse needs of our student population will occur only if we have teachers in every classroom who have content knowledge and a repertoire of effective instructional strategies. These strategies must focus on staff belief systems so that the relationship between teacher expectations and student achievement is directly addressed.

Teachers, principals, and support staff must focus on increasing capacity in a collegial, continuous improvement manner. Principals and other instructional leaders must know what to look for in the classroom in order to support and evaluate staff in improvement efforts. They must have the methodology to measure great teaching, including attitudes and belief systems. By implementing our new Teacher Evaluation System, staff development efforts will be focused and accountable. Innovative system reforms include the following:

- Implementing the Skillful Teacher and Skillful Leader training models to ensure that teachers and instructional assistants have the knowledge of instructional strategies and a direct approach to addressing expectations and that principals and other evaluators know how to effectively assess teaching
- Assigning staff development teachers at each school to provide a job-embedded approach for increasing skills sets
- Implementing a Peer Assistance and Review program to support and evaluate new and underperforming teachers in order to ensure that high quality teaching is occurring
- Providing mentors and training for all new teachers to ensure a strong induction program that focuses on content, strategies, and high expectations
- Assigning instructional experts at the central office to provide direct services to schools so that breakthrough practices are studied and implemented
- Requiring coordination among all offices to ensure alignment of content and process support by creating a leadership team to organize and monitor staff development
- Establishing a Workforce Excellence Institute to increase the capacity of principals and other leaders in the school system

A coordinated staff development program is fundamental to improved student results in mathematics and all curricular areas.

Instructional Leadership

The principal makes a big difference. The research is clear that schools are successful when the principal is a strong instructional leader. Principals – working closely with community

superintendents and other instructional leaders of the school system – must articulate and monitor the achievement of high standards and expectations for all students, make data-driven decisions, implement research-based practices, and systematically monitor student performance to ensure that all students are successful. The principal selection process has been revised and the principal training program has become more rigorous, shifting the emphasis on the principal as instructional leader.

Principal competencies have been drafted to form the organizing framework of a new principal evaluation system for the 2000-2001 school year to be completed this year. Principals received training this past summer on analyzing data, and currently further training is being planned to increase their effectiveness as data-driven decision-makers. Community superintendents, directors of school performance, and their newly established school performance teams now will continue to work closely with principals to assist and monitor the instructional program. Strong instructional leadership by principals is critical as schools focus on raising the bar and closing the achievement gap.

Policy

The findings from the curriculum audit suggest that an overarching coherent curriculum management policy would be more effective than the current approach that provides curricular direction by levels: early childhood, elementary education, middle school, and high school. This fragmentation may have contributed to the inadequacies of our governance system as defined by the auditors' five standards for efficient policy development. Specifically, eight out of 22 criteria – addressing control, direction, connectivity and equity, feedback, and productivity – were met for the 21 policies, regulations, and exhibits reviewed by the auditors.

An internal policy analysis will be conducted by the Office of Shared Accountability and assisted by the Office of Instruction and Program Development to address gaps in the governance infrastructure. Policies have already been secured from the National School Board Association; the Association for Supervision, Curriculum and Development; and districts recognized for their comprehensive approach to curriculum management.

Evaluation and Assessment

Preliminary findings from the Office of Shared Accountability investigation of Algebra I results suggest changes that will need to be made in the way assessment results are used to determine student course placement and algebra readiness. This is particularly true in providing school-based staff with timely and detailed information about the progress of individual students. Such measurements and data analysis will need to be detailed enough to permit adjustments to the instructional program prior to student failure and the need for remediation. Using data and analysis for intervention strategies is far more effective than an accountability measure that comes too late to provide assistance to individual students. We need to pinpoint earlier the areas necessary for improvement in the delivery of the instructional program.

At this time, active consideration is being given to changes in the testing and measurement efforts that would support the realignment of the instructional program with existing state and

national assessments, including the Maryland School Performance Assessment Program. This includes consideration of whether strictly internal assessments, such as the criterion-referenced tests and the Instructional System in Mathematics, are necessary and appropriate, given a realignment of the curriculum with state standards and expectations. Certainly, the audit of the math curriculum suggests that the concurrent use of internal and external assessment measures dilutes instructional time, energy and resources that would be better directed at fulfilling the standards and expectations of the state program. The Office of Shared Accountability will be bringing forward recommendations on this topic during its presentation of the System of Shared Accountability on October 17, 2000.

The impact of the school environment and educator expectations on student achievement is critical. While it is difficult to see what people think and believe, it is often reflected in what they say and how they behave. The two indices within the school component of the System of Shared of Accountability – equity and quality – will give us the power to measure and monitor both student and teacher academic self-efficacy. There are fundamental questions that must be answered:

- *Do students believe they can learn, and do they have teachers who believe in them?*
- *Do teachers believe all students can learn, and do they have the ability to teach them?*
- *Does our school system have the capacity to ensure quality teaching?*

By monitoring student, teacher, and parent perceptions, we will be able to determine whether or not staff development efforts are increasing the capacity of our teachers to address the needs of a diverse work force as measured by increases in student achievement.

In Conclusion

At the heart of these efforts is the profound desire to create the strongest mathematics program possible, raise the expectations for student achievement across the school system, and propel student performance to the highest levels of national and international standards. The challenge is clear. We must continue to build the capacity of our school system – through focused use of resources, continuous staff development, effective evaluation, and alignment of curriculum with instruction – to ensure that we not pause for a moment in the academic preparation of even one student.

At the table for the discussion tonight are Dr. Pamela Hoffler-Riddick, associate superintendent for shared accountability; Mrs. Judith Muntner, associate superintendent for instruction and program development; Dr. William Poston, lead auditor of the mathematics curriculum audit; Mr. Joseph I. Headman, Jr., community superintendent; Mr. Dale Fulton, director of high school instruction; Dr. Leah Casey Quinn, supervisor of mathematics; and Ms. Darlene Merry, director of staff development.

JDW:kmy

Attachments